Laser Physics 2009 vol.19 N4, pages 836-854

Analysis of biomedical signals by flicker-noise spectroscopy: Identification of photosensitive epilepsy using magnetoencephalograms

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Abstract

The flicker-noise spectroscopy (FNS) approach is used to determine the dynamic characteristics of neuromagnetic responses by analyzing the magnetoencephalographic (MEG) signals recorded as the response of a group of control human subjects and a patient with photosensitive epilepsy (PSE) to equiluminant flickering stimuli of different color combinations. Parameters characterizing the analyzed stochastic biomedical signals for different frequency bands are identified. It is shown that the classification of the parameters of analyzed MEG responses with respect to different frequency bands makes it possible to separate the contribution of the chaotic component from the overall complex dynamics of the signals. It is demonstrated that the chaotic component can be adequately described by the anomalous diffusion approximation in the case of control subjects. On the other hand, the chaotic component for the patient is characterized by a large number of high-frequency resonances. This implies that healthy organisms can suppress the perturbations brought about by the flickering stimuli and reorganize themselves. The organisms affected by photosensitive epilepsy no longer have this ability. This result also gives a way to simulate the separate stages of the brain cortex activity in vivo. The examples illustrating the use of the "FNS device" for identifying even the slightest individual differences in the activity of human brains using their responses to external standard stimuli show a unique possibility to develop the "individual medicine" of the future. © 2009 Pleiades Publishing, Ltd.

http://dx.doi.org/10.1134/S1054660X09040434